Greenfort International Journal of Applied Medical Science
Abbreviated Key Title: Grn Int J Apl Med Sci
ISSN 3048-6904(P) | ISSN 2584-2420(O)
Journal homepage: https://gijams.in

Research Article DOI: 10.62046/gijams.2026.v04i01.001

Pirani score Outcome of Relapsed Clubfoot treated by Re-Ponseti Technique: Case series Analysis

Mabrouka AM Omar Alwafi[1,2]*, Yaminah Ahmed Abrahem Alharawi[1,2], Abdalslam Abdalanis Abdalhfed Mohmed[1,2], Misbah Salih Misbah Salih[1,2], Rajab M Elsalaty[1,2], Waeil I.T Kawafi[3,4]

[1]Department of Surgery, Faculty of Medicine, University of Benghazi
[2]Department of Orthopedic Surgery, Aljalla Hospital, Benghazi
[3]Department of Family & Community Medicine, Elmarj Faculty of Medicine, University of Benghazi
[4]The Libyan Board for Medical Specialties, General Practice

Corresponding Author: Mabrouka AM Omar Alwafi | Email: mabrouka.alwafi@uob.edu.ly
Received: 09.11.2025 | **Revised:** 20.12.2025 | Accepted**:** 29.12.2025 | **Published:** 02.01.2026

Abstract: BACKGROUND: clubfoot is by far the commonest congenital abnormality of foot. The early treatment with Ponseti technique is mandatory because of it is impressive results world widely. OBJECTIVE: aim of study is to assess the effects of using reponseti for relapsed patients with clubfoot treated initially with Ponseti at Aljalla hospital. METHODS: Sixty-six patients who have different patterns of deformity relapsing were reoperated at different ages and Pirani score was reported before and after the procedure. Statistical analysis was achieved with software SPSS 27.0 with application of Monovariate and multivariate tests. RESULTS: Paired values analysis shows a statistically significant improvement (units of score decline). A statistically significant difference was found only with family history of the condition (family history of clubfoot deformity seems to be in favor of better improvement) and Pirani score after relapse, i.e., before re-Ponseti procedure (higher baseline score was in favor of better improvement). Only two independent predictors were found statistically significant at level of confidence of 95%, Pirani score after relapse (before repeat operation) and equinus deformity as an inverse (negative) predictor. CONCLUSION: Ponseti technique still proves efficacy even as a repeat operation for recurrent clubfoot deformity. Patients with worse degrees may gain better outcome but equinus type deformity may poses less promising outcome.
Keywords: Aljalla hospital, relapsed clubfoot, Ponseti technique, Pirani score.

Citation: Mabrouka AM Omar Alwafi *et al.* Pirani score Outcome of Relapsed Clubfoot treated by Re-Ponseti Technique: Case series Analysis. Grn Int J Apl Med Sci, 2026 Jan-Feb 4(1): 1-5.

INTRODUCTION

Clubfoot or, the formally known as congenital talipes equinovarus, is a common congenital pediatric foot deformity in the orthopedic surgical practice. Deformities of the clubfoot include equinus of the ankle, varus of the hindfoot, as well as cavus and forefoot adduction with subsequent atrophy of the calf muscles [1, 2].

In clubfoot, the presentation is most commonly an isolated congenital condition. Nevertheless, clubfoot may be associated with other conditions such as myelomeningocele or arthrogryposis [3].

No direct well described cause for clubfoot. A multifactorial model including both genetic and environmental factors is likely fitting [3-5].

The epidemiology of the condition varies with genetic background, gender and race. According to epidemiological studies, there is a described higher rate among first-degree relatives than among more distant relatives. The incidence is often between 0.4 and 2.0/1000 live births, commonly averaged to around one per 1000 live births [6-9].

Regarding gender differences, about two-thirds of the affected children are males, and half of them have bilateral involvement. A slight right-sided preponderance as noted in some researches among those with unilateral lesion [10].

Recent publications relevant to African and American regions described an incidence of 1.11 per 1000 in African countries and the 1.74 per 1000 in America [11-13].
The technique that is currently considered as the golden standard for treatment of clubfoot is Ponseti method which applies weekly strict manipulation and casting. If rigid equinus found an Achilles tenotomy is performed in addition to correction of all other deformities of the foot. This is followed by use of brace for four to five years [14].

©The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0) that ensures authors retain full ownership of their published work. This license permits any non-commercial use, sharing, adaptation, distribution, and reproduction in any medium or format, as long as appropriate credit is given to the original authors and the source.

The success rate of Ponseti technique may exceed 90% for initial correction. However, relapses do occur with a variable rate between 10% and 30% according to the duration of follow up [15-17].
The definition of clubfoot relapse is the recurrence of any component of deformity after a complete correction of condition. Regardless of the mode of treatment, the club foot anyhow tends to relapse [18,19].

Clubfeet relapses have also been classified as minor and major depending on the extent of invasive surgery required on these feet [20-23].

Repeat Ponseti remains the available rational intervention for relapsed clubfoot. The evaluation of this situation is still undergoing scrutiny [16,17].

The aim of this study was to assess the effectiveness of a repeat of the Ponseti method in treatment of relapsed clubfeet with various types of deformities.

METHOD

This was a study of case series collected between (sep2023-jun2024) included 66 patients with 106 relapsed idiopathic clubfoot seen and treated in the clubfoot clinic of ALJALLA hospital; the largest governmental surgical hospital in the eastern part of the country and the only dedicated center for clubfoot with a population of nearly more than 1 million.

Inclusion criteria were the entire patient's demographics age, sex, order, place of birth, family history, previously treated with Ponseti at birth, affected site, severity of clubfoot at presentation. While the syndromic clubfeet, neurogenic clubfeet and post-surgical relapsed clubfeet were excluded.
Pirani scoring system was applied for all the patients. Informed consent was taken from the parents after explaining the mechanism of deformity and techniques for correcting this deformity and the complications.

Data analysis was done with (SPSS) a statistical package for social sciences version 27. Quantitative variables were expressed as means and standard deviation. The change in score units was directly tested using Wilcoxon Signed Ranks Test. Regarding comparison, the categories were classified according to improvement in Pirani score (score improvement ≥ 2 score units versus 0 or one change in score units). Pearson's Chi-square test (or the alternative Fisher's exact test) of significance were used to compare categorical case characteristics. Mann-Whitney U test was applied to compare numerical characteristics (non-normally distributed according to Kolmogorov-Smirnov test). All of the characteristics tested for difference in response categories were analyzed as predictors for better improvement using logistic regression to test for independent predictors.

RESULTS AND DISCUSSION

A total of 66 children that had a relapsed after managed by Ponseti technique at initial presentation now included in the study. In relapse 26 (39.39%) children had unilateral involvement in which the right foot was 15 and the left foot was 11.And the other 40 (60.61%) children had bilateral involvement. In addition, the deformity pattern sub grouped to 3 types, adduction; 29 children, equinus; 27 children, and severe; 15 children. All the cases underwent Pirani score before and after Re-Ponseti (repeat operation).

Table (1) shows the distribution of the case characteristics, age, gender, order of the patient among siblings, family history and characteristics describing the deformity.

Table (1): Demographic and case characteristics of the study series

Characteristic	Category	n/66 (%)
Age	Age Range: 1 – 16, mean ± SD; 7.18 ± 3.11, median: 6, Interquartile range: 5 - 9	
Age group	1 - 5 years	19 (28.8%)
	6 - 10 years	37 (56.1%)
	Older than 10	10 (15.2%)
Age on relapse	Age Range: 1 – 14, mean ± SD; 4.47 ± 2.58, median: 4, Interquartile range: 3 - 6	
Age group on relapse	1 - 5 years	46 (69.7%)
	6 - 10 years	20 (30.3%)
Gender	Male	49 (74.2%)
	Female	17 (25.8%)
Family history	Positive	12 (18.2%)
	Negative	54 (81.8%)
Involved side	Bilateral	40 (60.6%)
	Right	15 (22.7%)
	Left	11 (16.7%)
Order among sibling	First	37 (56.1%)
	Second	13 (19.7%)

Copyright: © Author(s), 2026. Published by Greenfort International Journal of Applied Medical Science | This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

	Third	9 (13.6%)
	Fourth	4 (6.1%)
	Fifth	3 (4.5%)
Type of deformity	Equinus	27 (40.9%)
	Adduction	30 (45.5%)
	Severe	9 (13.6%)

n: number of cases with ascertained characteristic. SD: standard deviation.

The median age on relapse was four years with range between one and fourteen years. Male gender was predominant (74.2%) with family history of an involved sibling positive in only one fifth of cases. In 60.6% of cases the deformity was bilateral. In more than half of cases the patient was the first sibling. The most common types of deformity were adduction then equinus ones.

Table (2) shows the analysis of measurements for Pirani score before and after the repeat operation. Paired values analysis shows a statistically significant improvement (units of score decline).

Table (2): Pirani score measurements of the study series

Pirani score after relapse **Range: 2 – 23, mean±SD (3.11 ± 0.95), median: 3, Interquartile range: 3 - 3**	
2	15 (22.7%)
3	39 (59.1%)
4	3 (4.5%)
5	8 (12.1%)
6	1 (1.5%)
Pirani score after re-Ponseti **Range: 0 – 01, mean±SD (1.11 ± 0.75), median: 1, Interquartile range: 1 - 1.25**	
0	12 (18.2%)
1	38 (57.6%)
2	13 (19.7%)
3	3 (4.5%)
*** Pirani score drop** **Range: 0 – 02, mean±SD (2 ± 0.80), median: 2, Interquartile range: 1.75 - 2**	
0	1 (1.5%)
1	15 (22.7%)
2	36 (54.5%)
3	11 (16.7%)
4	3 (4.5%)
Improvement in units of Pirani score (>1)	
Yes	50 (75.8%)
No or poor	16 (24.2%)

* $P < 0.001$ (By Wilcoxon Signed Ranks Test). Statistically significant difference.

Table (3) shows the analysis of differences in Pirani score improvement status according to case baseline characteristics. A statistically significant difference was found only with family history of the condition (family history of clubfoot deformity seems to be in favor of better improvement) and Pirani score after relapse, i.e. before re-Ponseti procedure (higher baseline score was in favor of better improvement).

Table (3): Differences in Pirani score improvement status according to baseline characteristics

Characteristic	**Category**	**Score improvement**		***P***
		> One unit	**Only 0 – 1 unit**	
Age on relapse; mean ± SD (median)		4.12 ± 2.438 (4)	5.56 ± 2.78 (5)	0.075 M
Age category on relapse n/N (%)	≤ 5 years	37/46 (80.4%)	9/46 (19.6%)	0.217 F
	> 5 years	13/20 (65.0%)	7/20 (35.0%)	
Gender n/N (%)	Male	35/49 (71.4%)	14/49 (28.6%)	0.205 F
	Female	15/17 (88.2%)	2/17 (11.8%)	
Family history n/N (%)	Positive	12/12 (100.0%)	0/12 (0.0%)	0.030 F *
	Negative	38/54 (70.4%)	16/54 (29.6%)	
Laterality	Bilateral	29/40 (72.5%)	11/40 (27.5%)	0.444 C

Copyright: © Author(s), 2026. Published by Greenfort International Journal of Applied Medical Science | This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

n/N (%)	Unilateral	21/26 (80.8%)	5/26 (19.2%)	
Type of deformity n/N (%)	Equinus	17/27 (63.0%)	10/27 (37.0%)	0.060 C
	Adduction	24/30 (80.0%)	6/30 (20.0%)	
	Severe	9/9 (100.0%)	0/9 (0.0%)	
Pirani Score after relapse; mean ± SD (median)		3.32 ± 0.96 (3)	2.44 ± 0.51 (2)	<0.001M*

n: number within characteristic category. N: improvement status number. M: Mann-Whitney U test. F: Fisher's exact test. C: Chi square test. SD: standard deviation.

Table (4) shows the results of multivariate analysis for predictors of Pirani score improvement beyond one unit. Only two independent predictors were found statistically significant at level of confidence of 95%, Pirani score after relapse (before repeat operation) and equinus deformity as an inverse (negative) predictor. See also figure (1).

Adjusted odds ratio for higher baseline Pirani score for success of repeat operation was 66.7 times (95% confidence interval of 3.9 – 1000.0). This may pertain to the higher range of correctable angle with promising chance of correctability. The higher the Pirani score on presentation (baseline score), the higher chance for better improvement.

Table (4): Multivariate analysis of predictor factors for Pirani score improvement

Factor	*P*	AOR	95% C.I. for AOR	
Age on relapse	0.084	0.416	0.154 -	1.125
Age category on relapse (≤ 5 years)	0.966	0.894	0.006 -	141.668
Gender (Male)	0.542	0.403	0.022 -	7.480
Family history for club foot	0.998	> 1000.0	0.000 -	> 1000.0
First sibling	0.608	0.578	0.071 -	4.717
Pirani score after relapse	0.004*	66.667	3.846 -	1000.000
Equinus deformity	0.012*	0.020	0.001 -	0.424
Intercept	0.999	0.000	//	//

AOR: Adjusted odds ratio. C.I. Confidence interval.
† Statistically significant at level of confidence of 95% (independent predictor)

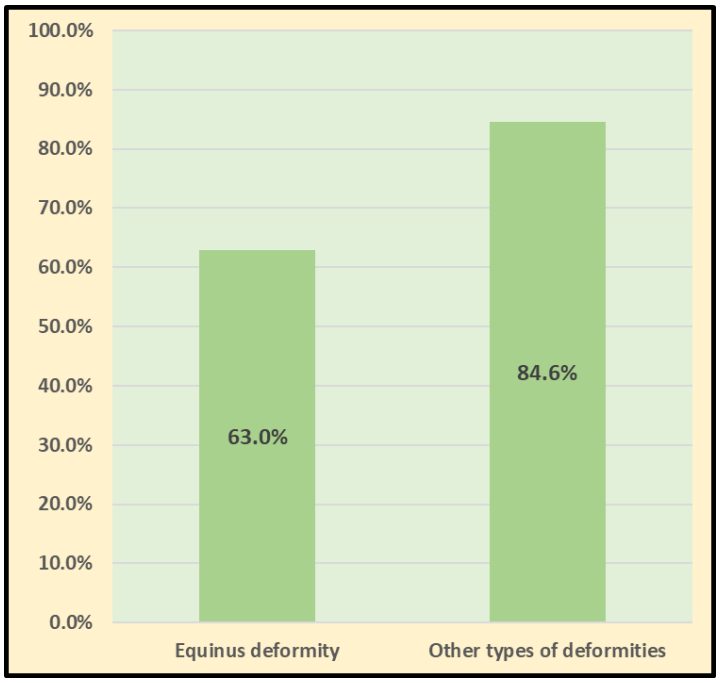

Figure (1): Comparison of the rate of improvement in Pirani score according to type of deformity.

In the other hand, equinus deformity is a negative independent predictor for better recovery with adjusted odds ratio for this type of deformities for success of repeat operation was as low as 0.02 (with 95% confidence interval of 0.001 – 0.424).

Family history of the deformity seems to exhibit a significant association with better improvement in Monovariate (explorative) analysis. Anyhow, this was not consistent in multivariate analysis and perhaps; this finding was biased by other factors in the study.

Copyright: © Author(s), 2026. Published by Greenfort International Journal of Applied Medical Science | This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

CONCLUSION

This study demonstrates that the Re-Ponseti technique remains a highly valuable and effective treatment option for relapsed idiopathic clubfoot in children initially managed with the traditional Ponseti method. A clear improvement in alignment and function was observed through post-treatment Pirani scores, reflecting successful correction in most relapse patterns, particularly adduction and equinus deformities. The relatively high relapse age highlights the essential role of continuous parental education and strict adherence to bracing protocols during follow-up years. Because it is minimally invasive, cost-effective, and technically reproducible, the Re-Ponseti method helps avoid extensive surgical procedures that may compromise long-term mobility and foot function. Overall, our findings reinforce that early detection of relapse and timely re-intervention using Re-Ponseti can restore positive outcomes and significantly enhance quality of life for children affected by this stubborn deformity.

Acknowledgement: None
Conflict of Interest: None
Source of Fund: None

REFERENCES

1. Wang H, Barisic I, Loane M, Addor MC, Bailey LM, Gatt M, et al. Congenital clubfoot in Europe: A population- based study. Am J Med Genet A. 2019; 179(4):595–601. https://doi.org/10.1002/ajmg.a.61067 PMID: 30740879
2. Moon DK, Gurnett CA, Aferol H, Siegel MJ, Commean PK, Dobbs MB. Soft-tissue abnormalities associated with treatment-resistant and treatment-responsive clubfoot: Findings of MRI analysis. J Bone Joint Surg Am. 2014; 96(15):1249–1256. https://doi.org/10.2106/JBJS.M.01257 PMID: 25100771
3. 3.Dobbs MB, Gurnett CA. Genetics of clubfoot. J Pediatr Orthop B. 2012; 21(1):7–9. https://doi.org/10.1097/BPB.0b013e328349927c PMID: 21817922
4. Lochmiller C, Johnston D, Scott A, Risman M, Hecht JT. Genetic epidemiology study of idiopathic talipes equinovarus. Am J Med Genetics 1998;79:90-96.
5. Cartlidge I. Observations on the epidemiology of club foot in Polynesian and Caucasian populations. J Med Genetics 1984;21:290-92.
6. Boo NY, Ong LC. Congenital talipes in Malaysian neonates: Incidence, pattern and associated factors. Singapore Med Journal 1990;31:539-42.
7. Wynne-Davies R. Genetic and environmental factors in the etiology of talipes equinovarus. Clin Orthopaed Related Res 1972;84:9-13.
8. Wang H, Barisic I, Loane M, Addor MC, Bailey LM, Gatt M, et al. Congenital clubfoot in Europe: A population- based study. Am J Med Genet A. 2019; 179(4):595–601. https://doi.org/10.1002/ajmg.a.61067 PMID: 30740879
9. Smythe T, Kuper H, Macleod D, Foster A, Lavy C. Birth prevalence of congenital talipes equinovarus in low- and middle-income countries: A systematic review and meta-analysis. Trop Med Int Health. 2017; 22(3):269–285. https://doi.org/10.1111/tmi.12833 PMID: 28000394
10. Nguyen MC, Nhi HM, Nam VQ, Thanh do V, Romitti P, Morcuende JA. Descriptive epidemiology of clubfoot in Vietnam: A clinic-based study. Iowa Orthop J. 2012; 32:120–124. PMID: 23576932
11. Pirani S, Naddumba E, Mathias R, Konde-Lule J, Penny JN, Beyeza T, et al. Towards effective Ponseti clubfoot care: the Uganda Sustainable Clubfoot Care Project. Clinical orthopaedics and related research. 2009; 467(5):1154–63. https://doi.org/10.1007/s11999-009-0759-0 PMID: 19308648.
12. Owen RM, Kembhavi G. A critical review of interventions for clubfoot in low and middle-income countries: effectiveness and contextual influences. J Pediatr Orthop B. 2012; 21(1):59–67. Epub 2011/08/04. https://doi.org/10.1097/BPB.0b013e3283499264 PMID: 21811182.
13. Penny JN. The Neglected Clubfoot. Techniques in Orthopaedics. 2005; 20(2):153–66
14. Ponseti IV. Congenital clubfoot. Fundamentals of treatment. Oxford University Press; 1996. PMID: 8981905.
15. Ponseti IV. Current concepts review: Treatment of congenital clubfoot. J Bone Joint Surg Am 1992; 74:448-54.
16. Ponseti IV, Smoley EN. Congenital club foot: The results of treatment. J Bone Joint Surg Am 1963; 45:261-75.
17. Bor N, Coplan JA, Herzenberg JE. Ponseti treatment idiopathic clubfoot: Minimum 5-year followup. Clin Orthop Relat Res 2009; 467:1263-70.
18. Ponseti IV. Congenital clubfoot: fundamentals of treatment. 1st ed. Oxford: Oxford University Press, 1996:61-97.
19. Goriainov V, Judd J, Uglow M. Does the Pirani score predict relapse in clubfoot? J Child Orthop 2010;4:439-444.
20. Owen RM, Kembhavi G. A critical review of interventions for clubfoot low- and middle-income countries: Effectiveness and contextual influences. J Pediatr Orthop 2012;21:59-67.
21. Ponseti IV. Relapsing clubfoot: Causes, prevention and treatment. Iowa Orthop J 2000;22:55-7.
22. Chu A, Lehman WB. Persistent clubfoot deformity following treatment by the Ponseti method. J Pediatr Orthop 2012;21:40-5.
23. Masrouha KZ, Morcuende JA. Relapse after tibialis anterior tendon transfer in idiopathic clubfoot treated by the Ponseti method. J Pediatr Orthop 2012;32:81-4.

Copyright: © Author(s), 2026. Published by Greenfort International Journal of Applied Medical Science | This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.